

Stairs had a narrow escape. It was afterwards found that the poison is manufactured from the dried bodies of red ants or pismires ground into powder, cooked in palm-oil, and smeared over the wooden points of the arrows. As might have been expected, the forest is haunted by myriads of insects of every variety, and it is to be hoped that a harvest of these have been gathered for the delight of the entomologists at home.

Mr. Stanley's description of the daily course of things in the forest region is worth quoting:—

"The mornings generally were stern and sombre, the sky covered with lowering and heavy clouds, at other times thick mist buried everything, clearing off about 9 a.m., sometimes not till 11 a.m. Nothing stirs then; insect life is still asleep, the forest is still as death, the dark river, darkened by lofty walls of thick forest and vegetation, is silent as a grave; our heart-throbs seem almost clamorous, and our inmost thoughts loud. If no rain follows this darkness, the sun appears from behind the cloudy masses, the mist disappears, life awakens up before its brilliancy. Butterflies scurry through the air, a solitary ibis croaks an alarm, a diver flies across the stream, the forest is full of a strange murmur, and somewhere up-river booms the alarum drum. The quick-sighted natives have seen us, voices vociferate challenges, there is a flash of spears, and hostile passions are aroused."

As to the river itself, the Aruwimi, or Ituri (it has several other names), is, with its windings, about 800 miles long, from its mouth in the Congo to its source almost on the edge of Albert Nyanza, though the course in a direct line is probably not more than 400 miles. The banks of the river, covered with forest from the Congo to the Nepoko (which is, after all, only a branch of the main river), are uniformly low, here and there rising to about 40 feet. Above the Nepoko, hills begin to crop up more frequently, palms are more numerous, and the woods show the tall, white-stemmed trees so characteristic of the slopes of the Lower Congo. While there are rapids at several places above Yambuya, above the Nepoko navigation becomes much more difficult, and rapids more frequent, while two considerable falls are met with. The land rises steadily until about 400 miles above Yambuya, the river is contracted into a rushing stream about 100 yards wide, banked by the steep walls of a cañon, the slopes and summits of which are clothed with wood. Whatever changes the face of the land may show, the forest covers peak, hill, ridge, valley, plain,—everywhere it is continuous, never broken, except at such clearings as man has made. Mr. Stanley very graphically compares the country traversed by his expedition to the long glacis of a fort rising from the Congo to a height of 5000 to 6000 feet; down the slope flows the Aruwimi, one of whose feeders runs almost within sight of Albert Nyanza, to which there is a sudden drop of 2900 feet.

"The main Ituri, at the distance of 680 miles from its mouth, is 125 yards wide, 9 feet deep, and has a current of 3 knots. It appears to run parallel with the Nyanza. Near that group of cones and hills, affectionately named Mount Schweinfurth, Mount Junker, and Mount Speke, I would place its highest source. Draw three or four respectable streams draining into it from the crest of plateau overlooking the Albert Nyanza, and two or three respectable streams flowing into it from north-westerly; let the main stream flow south-west to near N. lat. 1°; give it a bow-like form N. lat. 1° to N. lat. 1° 50'; then let it flow with curves and bends down to N. lat. 1° 17' near Yambuya, and you have a sketch of the course of the Aruwimi or Ituri from the highest source down to its mouth, and the length of this Congo tributary will be 800 miles."

Here, then, we have remarkable hydrographical conditions. Only a few minutes' walk separates the feeders of the Congo and the Nile in this particular region. On the

other side, again, are found streams flowing into the south of Victoria Nyanza rising close to others which run into Lake Tanganyika, which again, through the Lukuga, is believed to be a feeder of the Congo. Still further south are found the main Congo stream and its feeders rising in such close proximity to the source of the Zambesi that it is difficult to discriminate between the one and the other. Mr. Stanley's own lake, the Muta Nzige, of which he heard again when in the neighbourhood, very probably belongs not to the Nile but the Congo. All this is full of interest, and geographers will look with impatience for the publication of Mr. Stanley's detailed narrative.

Another fact of great interest Mr. Stanley refers to—the existence of a snowy mountain which may rival Kilimanjaro (19,000 feet), in the neighbourhood of Mount Gambaragara, or Gordon Bennett, between Albert Nyanza and Muta Nzige. This may be Mount Gordon Bennett itself, but Mr. Stanley does not think so, and he is supported by the few data which he furnishes. It would be quite in accordance with what we find in other parts of the world that a group of high peaks should be found together.

One other point of geographical interest is Mr. Stanley's observation that the Albert Nyanza is rapidly decreasing in size. A century or perhaps more ago, the lake must have been twelve or fifteen miles longer, and considerably broader opposite Mbakovia, than it is now. With the wearing away of the reefs obstructing the Nile below Wadelai, the lake has rapidly receded, and is still doing so, to the astonishment of Emin Pasha, who first saw Lake Albert seven or eight years ago. It is to be hoped that Mr. Stanley will find time further to investigate this subject, as well as to explore the country between the Albert Nyanza and Muta Nzige, settle the position and outline of the latter, and ascertain precisely to what river system it belongs.

The abruptness with which the forest comes to an end and the rich grass lands begin, about eighty miles from Albert Nyanza, is another point deserving special attention, and can only be explained when we have accurate observations of the rainfall and other conditions that go to form climate.

Such are some of the more important geographical results of Mr. Stanley's expedition, so far as we can gather from his preliminary letters; others may be derived from the map which accompanies his papers. More will no doubt follow. It is to be hoped that the rumour of Emin's return is not true, or at least that if he is coming to Europe he has left his province in efficient hands. In the interests of science as well as of humanity, it is important that the province which Emin has held so long may not be allowed to relapse into barbarism.

J. S. K.

A NEW PERMIAN RHYNCHOCEPHALIAN REPTILE.¹

AMONG the many publications which have recently startled the palæontological world, one of the most important is unquestionably Dr. Hermann Credner's description of *Palæohatteria*, a new Permian Rhyngocephalian from the Plauen beds near Dresden—beds which have supplied the same author with copious material of Stegocephalians, both in the perfect and larval stages, the subject of his well-known admirable monographs. Great interest attaches to the present discovery from a purely zoological point of view, owing to the close relationship of this, one of the earliest of Reptiles, to the existing New Zealand *Sphenodon* (or *Hatteria*), the anatomy of which was first made known some twenty years ago by Dr. Günther in his classical paper in the Philosophical Trans-

¹ H. Credner, "Die Stegocephalen und Fauna aus dem Rothliegenden des Plauenschen Grundes bei Dresden," vii. Theil. *Palæohatteria longicauda* (Zeitschr. Deutsch. Geol. Ges., 1888, pp. 437-557, Pl. xxiv-xxvi.).

actions (vol. clvii., 1867). Since that time *Sphenodon* (of which very few specimens were then known, and which was even supposed to be nearly extinct) has been found in abundance on various small islands in the Bay of Plenty, and has come into the hands of many anatomists, to the great benefit of reptilian morphology. An investigation of the development of this type is, unfortunately, still a desideratum, which, when supplied, cannot fail to throw great light upon the phylogeny of the Reptilia.

On the ground of its osteological structure and of the absence of copulatory organs, *Sphenodon* was recognized by Dr. Günther as the type of a distinct order, the *Rhynchocephalia*, a view in which he has been followed by Prof. Cope, who even goes further, and, very correctly as we think, approximates them to the *Plesiosauria* and *Chelonina*. However, the authority which attaches to the views of Prof. Huxley, who demurred to the ordinal separation of the *Rhynchocephalia* from the *Lacertilia*, has deterred a great number of systematists from accepting the order, and among these we find Dr. Credner still terming *Hatteria* a Saurian. Now, if the Saurians are to include the Rhynchocephalians, it seems unnecessary to divide the Reptiles into orders at all; we may safely say that, as far as our present knowledge goes, the difference between the Rhynchocephalians and the Lacertilians is ten times greater than that between the former and the Plesiosaurians, or between Crocodilians and Dinosaurians, and many times more so than between *Lacertilia* and *Ophidia*. The two latter are accepted as orders by those who refuse that rank to the *Rhynchocephalia*, but they hardly deserve to be looked upon as more than sub-orders in a group to be termed, in virtue of the law of priority, the *Squamata*. The *Rhynchocephalia* must be regarded as the most generalized of all recent and, perhaps, of all known Reptiles; in many points they approach the Stegocephalous Batrachians, and it is possible that the common ancestors of the *Chelonina*, the *Plesiosauria*, and the *Lacertilia* would fall in this order.

The following is Dr. Credner's definition of the new genus *Palæohatteria*:—

Habitus, that of a long-tailed lizard, 16 to 18 inches long, with robust limbs.

Vertebral column consisting of about six cervical, twenty dorsal, three or four distinct sacral, and fifty to fifty-five caudal vertebræ. Vertebral centra, solid amphicæulous sheaths which constrict but do not interrupt the notochord. Neural arches united to the centra by suture. Dorsal vertebræ with long anterior, caudal vertebræ with long posterior articular processes; no transverse processes; spinous processes of dorsal vertebræ elevated, with rounded upper border, decreasing rapidly on the tail to small tubercles, more and more posterior in position, and finally entirely disappearing. Small wedge-shaped intercentra between all præ-caudal and the anterior caudal centra; from the sixth caudal vertebra they are modified into chevrons. All præ-sacral, sacral, and the seven anterior caudal vertebræ with ribs. Dorsal ribs long and curved; cervicals straight; last dorsals short and feebly curved; sacrals short and stout; caudals short, hooked. Proximal extremity of ribs expanded, not divided into capitulum and tuberculum.

Skull pointed and compressed; orbits large and circular, with sclerotic ring; nostrils small, anterior; latero-temporal fossæ comparatively small. Dentition acrodont, the teeth acute and conical, slightly curved backwards at the extremity; a thin coating of dentine, which on the inner side of the basal third shows slight grooves. Præ-maxillaries distinct, each with three or four slender somewhat more strongly-curved teeth. Maxillary extending high up, armed with sixteen to eighteen teeth, of which the sixth and seventh are enlarged. Nasals nearly as long as the frontals. A large lachrymal between præ-frontal and maxillary. Jugal bordering the orbit inferiorly, bifurcating posteriorly into an ascend-

ing and a horizontal branch; the former forms with the post-orbital and the post-frontal a vertical post-orbital bar, the latter a horizontal bar with the quadrate.¹ Squamosal curved, fan-shaped, in contact anteriorly with the post-orbital, posteriorly with the horizontal branch of the jugal and with the quadrate. Basisphenoid a trapezoid plate with short lateral processes, with two small perforations near its anterior extremity, which tapers to the pointed præ-sphenoid. Vomer with hatchet-shaped groups of small teeth. Palatines with a series of teeth, parallel to the maxillaries, on the outer border. Mandibular ramus slender, straight, without coronoid process, formed of articular, angular, supra-angular, dentary, and probably also opercular and splenial.

Pectoral arch consisting of a long styloform episternum [interclavicle], which expands anteriorly into a small rhombic plate; two elbow-bent clavicles, overlapping the inner side of the episternal expansion; two crescentic scapulæ, truncate at each end and strongly thickened on the posterior border; and two non-perforated roundish coracoids.

Pelvis consisting of three paired elements, viz. a short massive ilium, with crest-like upper expansion and two diverging lower processes; a triangular posteriorly produced ischium; and a transversely oval, plate-shaped pubis with obturator foramen.

Limbs strong and stout, the posterior a little longer than the anterior. Distal extremity of humerus much expanded, with ectepicondylar foramen. Carpus with eight or nine ossified elements; tarsus formed of calcaneum, astragalus, and five tarsalia; five metacarpals and five metatarsals; five digits to both limbs, the first with two, the second with three, the third with four, the fourth with five, and the fifth with three phalanges, of which the distal is a sharp curved claw.

Abdominal ribs probably present, and formed of numerous small filiform bones.

An *armour* of small oat-seed-shaped scales, forming posteriorly diverging series, restricted to the ventral region between both pairs of limbs.

Among the most salient features in the structure of the new Reptile, as compared with other Rhynchocephalians, are the pelvis and the tarsus. The crest-like expansion of the costal border of the ilium and the bifurcation of its acetabular extremity, are, to a certain extent, Crocodilian or Dinosaurian, whilst the pubis and ischium appear to us to bear the greatest resemblance to the same in Plesiosaurians. It is also in the latter group that we have to look for so primitive and Batrachian-like a tarsus; for the tarsus of *Palæohatteria* affords an exact repetition of that of the likewise Permo-Carboniferous Plesiosaurian *Stereospermum*, which, on the ground of its five distal tarsalia has been made the type of an order, *Proganosauria*, by Dr. Baur. The close similarity of the dentition of *Palæohatteria* and that of certain contemporary Stegocephalians, especially *Dendrerpeton* and *Hylonomus*, is highly suggestive of relationship, and we are not surprised to hear from Dr. Credner himself of his having at first felt uncertain as to the class to which the fossil should be referred. Although unquestionably related to *Sphenodon*, *Palæohatteria* has, we venture to think, yet hardly a claim to enter the *Hatteridae*, and it would have been better had the author established for it a new family. The archaic condition of the humerus with both ent- and ect-epicondylar foramina, the presence of uncinatæ processes to the ribs, the absence of a ventral armour, the presence of a coronoid process in the mandible, and the share taken by the maxillary in the formation of the border of the orbit, a character common to the Chelonians and Plesiosaurians and certain Lizards, but not found in the Stegocephalians, the Ichthyosaurians, the Crocodilians, nor, we believe, in the other Rhynchocephalians, are

¹ What Dr. Credner calls "quadrate" is in reality quadrate + quadrato-jugal.

sufficient grounds for regarding the *Hatteriidae*, with the single genus *Sphenodon*, as a different family.

Dr. Credner's paper also contains, incidentally, information on *Proterosaurus*, the structure of which is still, in spite of Prof. Seeley's recent investigations, very imperfectly known. In an example preserved in Freiberg, the author has discovered the interclavicle and clavicles, the former element closely resembling the same in *Palæohatteria*, whilst the latter is distinguished by its plate-like proximal expansion, which bears special resemblance to the so-called lateral pectoral plates of certain Stegocephalians. It appears almost certain that *Proterosaurus* was a Rhynchocephalian, but in many respects more specialized than *Palæohatteria*, intercentra being present only between the anterior cervical vertebræ, and the tarsus containing only six elements—three in the proximal and three in the distal row. G. A. BOULENGER.

THE SPECTRUM OF THE RINGS OF SATURN.

AN interesting note on the spectrum of Saturn's rings was communicated to the Royal Society on February 7 by Mr. Norman Lockyer. It has long been known that the rings are considerably more luminous than the planet, and the photographs by the Brothers Henry show that this is truer for the blue light than the more visible rays. It is therefore possible that they shine partly by their own light, and since it is now universally acknowledged that they consist of small bodies in motion, their spectrum has an important bearing on the meteoric hypothesis. Mr. Lockyer suggested that the additional luminosity might be due to collisions, and in order to determine whether the collisions were of sufficient intensity to produce incandescent vapours or not, he asked one of his assistants, Mr. Porter, to obtain a photograph of the spectrum. This was done at the Astronomical Laboratory at South Kensington, with a spectroscope having two prisms of 60° attached to the eye-end of the 10-inch equatorial. The photograph was taken with an exposure of about two hours, and shows decided indications of bright lines. Mr. Lockyer says:—"It is altogether too early to announce this as an established fact, but I think it well to send this note, in order that other observers with more powerful optical appliances and a better climate than that of London may investigate the question."

It is therefore very desirable that further inquiry should be made, both by photographic and eye observations. The bright flutings of carbon at wave-lengths 517, 474, and 564 should receive particular attention, the flutings being easily obtained for comparison from the flame of a spirit-lamp or wax vesta. Brightnesses may possibly occur also in the positions of the magnesium flutings at λ 500 and 521, the lead fluting at λ 546, and the manganese fluting at λ 558, all of which may be conveniently obtained for comparison by volatilizing the chlorides of these substances in the flame of a spirit-lamp or Bunsen burner.

It may be expected that the brightenings will be very feeble, owing to the masking effects of the more abundant solar light, so that the photographic method will probably give the best results on account of its power of integration.

In the same note, Mr. Lockyer states that "other considerations point to the possibility that bright lines or bands may be found in the spectrum of Uranus." A. F.

ON THE SPEED OF THE ELECTRIC TRANSMISSION OF SIGNALS THROUGH SUBMARINE CABLES AND LAND WIRES.

ELECTRO-TELEGRAPHIC operations for the determination of differences of longitude are usually so arranged as to furnish determinations of the speed of transmission of the electric signals. Each of two stations which are telegraphically connected is provided

with a clock, and usually with a chronograph also; thus the clock-times at either station may be registered at will on the chronographs at both stations. The difference between the times indicated by the two clocks at any moment is thus readily ascertained, and two values of it will be obtained, one with the current transmitted in one direction, the other with it transmitted in the opposite direction. The difference between these two values indicates the sum of the speeds in both directions; and half the difference is usually called the "retardation on the line," as it indicates the amount by which every signal, on arrival at its destination, is slow on the time of its inception.

This method of determining the velocity is very simple and very exact; it does not require a knowledge of the errors of the clocks, or even of their rates, for the rates cannot sensibly alter in the brief interval between the signals with reversed currents, which need never exceed a few minutes.

The operations of two officers of the Indian Survey, Lieut.-Colonel Campbell, R.E., and Major Heaviside, R.E., for determining the differences of longitude between Bombay, Suez, and Aden,¹ furnish measures of the speed through two submarine cables which happen to be practically identical, though one cable was 355 knots, or as much as one-fourth, longer than the other cable. I gave the figures to Mr. W. H. Preece, of the Postal Telegraph Department, and he has found that they are very closely accordant with the theoretical speeds, calculated with due recognition of the different electrical conditions of the two cables. This is shown in the following table, in which Mr. Preece also gives the corresponding values by calculation and observation for the French Atlantic cable:—

Cable.	Length (knots).	Resistance (R) per knot.	Capacity (K) per knot.	KR per knot.	$L^2 \times KR$ per knot.	Thomson's constant, $u = \frac{1}{2535} \times \frac{1}{KR}$.	Apparatus line constant $u \times 155$.	Observed speed.
Suez-Aden ...	1464	10.26	358	3.67	7865162	sec. 1809	sec. 280	sec. 280
Aden-Bombay ...	1819	6.60	361	2.38	7874851	sec. 1811	sec. 281	sec. 284
French Atlantic..	2584	2.93	43	1.26	8413090	sec. 196	sec. 303	sec. 3

For the speed of electric transmission through land lines, German geodesists have constructed an empirical formula on the assumption that the speed = $xl + yl^2$, l being the length of the line, and x and y two constants to be determined by observation. It is shown in the *Astronomische-geodätische Arbeiten* for the years 1883-84 and 1885-86, that, expressing l in kilometres,

$$\text{the speed} = 0.0000208s. l + 0.0000000206s. l^2$$

on the evidence of seventeen longitudinal arcs; and that on employing this formula to calculate the corresponding speeds in six arcs subsequently measured, the values obtained were found to differ 38 per cent. on the average from the observed speeds, and were generally quicker. This formula, however, takes no account of any differences in the electrical conditions of the lines. It gives 0.206s. and 0.302s. as the speeds of transmission through land lines 2700 and 3360 kilometres long, the lengths of the cables Suez-Aden and Aden-Bombay. The formula, however, cannot be legitimately applied to such long lines, for the longest of the seventeen on which the speeds were determined by observation, that from Berlin to Paris, was only 1230 kilometres. J. T. WALKER.

13 Cromwell Road, London, April 3.

¹ See vol. ix. of the "Account of the Operations of the Great Trigonometrical Survey of India," (Dehra Dun, 1883.)